

**Part 1: Algebraic Writing (15 points)** Use complete sentences to answer the questions below.

1. A friend tells you that the relationship between the height of a sunflower and the number of hours of sunlight it gets is a real-life example of an algebraic function. Do you agree or disagree? To earn full points, you must (1) provide a definition of a function, and (2) explain how the situation does or does not fit the definition you have provided.

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2. Explain the main differences between *linear* functions, *exponential* functions, and *quadratic* functions.

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3. **Draw** and **explain** the difference between the **solution** to a linear equation and a **solution** to a system of linear equations. Please use correct algebraic terms when appropriate.

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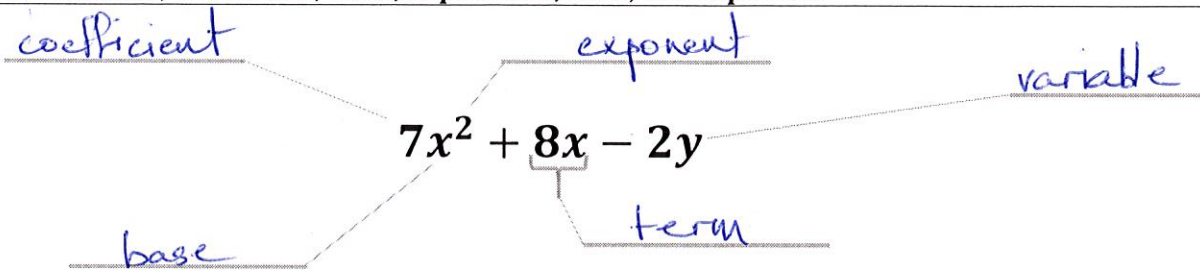
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**Part 2: Algebraic Vocabulary (6 points)**

4. Label the **variable**, **coefficient**, **term**, **expression**, **base**, and **exponent**.



The whole thing: expression

**Part 3: Simplifying Expressions (16 points)** Simplify the following expressions *completely*. Show all your work and **BOX** your final answer.

5.  $-5(4x - 6) =$   $-20x + 30$

6.  $3(y + 7) - 2(y - 4)$

$\underline{3y} + \underline{21} - \underline{2y} + \underline{8}$

$y + 29$

7.  $3x + y + 7 + x + y - 2x + 3$

$2x + 2y + 10$

8.  $(4x - 6)(5)$

$20x - 30$

**Part 4: Solving Equations (20 points)** Solve the following equations. BOX your final answer.

9.  $-6 + x = 11$   
 $+6 \quad +6$

$$\boxed{x = 17}$$

10.  $-5y + 1 = 21$   
 $-1 \quad -1$

$$\frac{-5y}{-5} = \frac{20}{-5}$$

$$\boxed{y = -4}$$

11.  $4(x + 3) = 2x - 6$

$$\begin{array}{r} 4x + 12 = 2x - 6 \\ -2x \quad -2x \end{array}$$

$$\begin{array}{r} 2x + 12 = -6 \\ -12 \quad -12 \end{array}$$

$$\frac{2x}{2} = \frac{-18}{2}$$

$$\boxed{x = -9}$$

12.  $\frac{2y}{7} = 6 \cdot 7$

$$\frac{2y}{2} = \frac{42}{2}$$

$$\boxed{y = 21}$$

13.  $\frac{3x}{8} = \frac{3}{2} \cdot 8$

$$3x = \frac{24}{2}$$

$$3x = 12$$

$$\boxed{x = 4}$$

**Part 5: Writing Equations (34 points)** Write the equation specified by each question. Show all your work and write your final answer in the box provided.

14. Write a slope-intercept form equation for the line that has a y-intercept of negative five and a slope of two.

$$y = 2x - 5$$

15. Write a slope-intercept form equation for a line that is *parallel* to the line in question number ~~fourteen~~ <sup>fourteen!</sup>

$$y = 2x + 1$$

16. Write a slope-intercept form equation for the line that passes through (6, -4) and (3, 8).

$$\begin{aligned}
 & -3 < \begin{matrix} 6, -4 \\ 3, 8 \end{matrix} > +12 \\
 & y = (m)x + (b) \\
 & m = \frac{\Delta y}{\Delta x} = \frac{+12}{-3} = -4 \\
 & y = -4x + b \\
 & 8 = -4(3) + b \\
 & 8 = -12 + b \\
 & \begin{array}{r} +12 \\ 8 \\ \hline 20 \end{array} = b
 \end{aligned}$$

$$y = -4x + 20$$

17. Write a slope-intercept form equation for the line that passes through (8, 4) and is parallel to the line:  $y = -3x + 7$

$$y = -3x + b$$

$$4 = (-3)(8) + b \quad b = 28$$

$$4 = -24 + b$$

$$y = -3x + 28$$

18. Write a slope-intercept form equation for the line that passes through (0, 5) and is perpendicular to the line:  $y = -\frac{1}{2}x - 12$

$$y = 2x + b$$

$$5 = 2(0) + b$$

$$5 = b$$

$$y = 2x + 5$$

19. Read the following scenario and answer the questions below:

Ana and Thalia both win a portion of the lottery and have a choice of how they want to be paid. Ana decides to get an initial payment of \$5,000 and be paid \$50 each day for a month. Thalia decides to take an initial payment of \$1 and have her money doubled each day for a month.

- a) **Fill in the blank.** One of these options is an example of *linear* growth; the other is an example of *exponential* growth. Which one is which?

Ana's choice is linear growth; Thalia's is exponential growth.

- b) Write an equation that shows how much money Ana will have received after  $x$  number of days

Equation:  $y = 50x + 5000$

- c) Write an equation that shows how money Thalia will have received after  $x$  number of days

Equation:  $y = 1.2^x$

- d) How much total money will Ana have received after 5 days? Show your work and BOX your answer.

$$y = 50(5) + 5,000$$
$$250 + 5,000 = \boxed{\$5,250}$$

- e) How much total money will Thalia have received after 5 days? Show your work and BOX your answer.

$$y = 1.2^5 = 1.32 = \boxed{\$32}$$

- f) If you were only going to be paid for twenty days, would you choose the option Ana chose or the option Thalia chose? To earn full points, you must **explain why**.

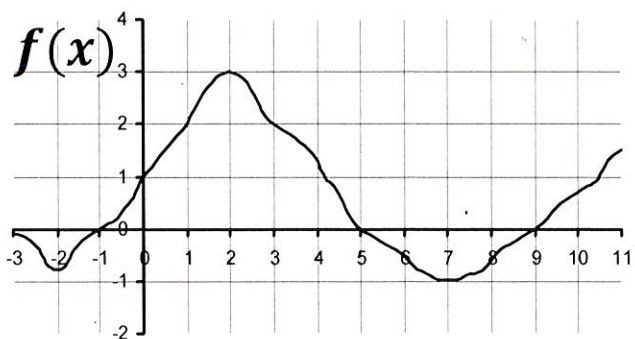
Ana  $y = 50(20) + 5,000 = 1,000 + 5,000 = \$6,000$

Thalia  $y = 1.2^{20} = \$1,048,576$

Explanation of choice: (write your own!)

**Part 6: Function Notation (18 points)**

20. Use the graph of  $f(x)$  and the equation  $g(x)$  to find the following values.

	$g(x) = 3x - 6$
$f(2) = 3$	$g(2) = 0$
$f(7) = -1$	$g(-3) = 3(-3) - 6 = -9 - 6 = \boxed{-15}$
<p>The value of <math>x</math> when <math>f(x) = 2</math></p> <p><math>x = 1</math> and <math>x = 3</math></p>	$g(f(3)) = f(3) = 2$ $g(2) = 0$ <div style="border: 1px solid black; padding: 5px; display: inline-block;"> <math>g(f(3)) = 0</math> </div>

## Part 7: Graphing and Naming Linear Equations

21. Graph the following linear equations (16 points). You must NAME and EXTEND your lines.

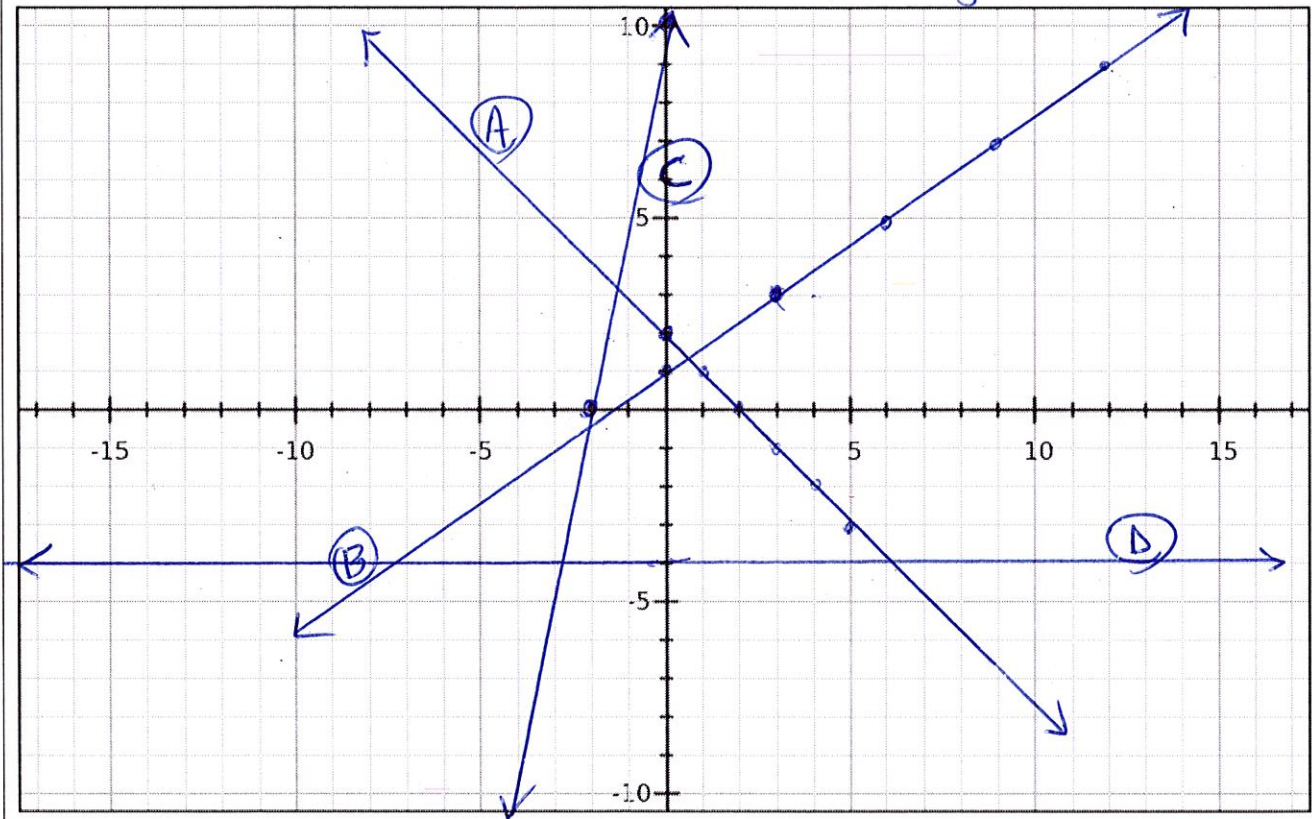
A)  $y = -x + 2$

B)  $y = \frac{2}{3}x + 1$

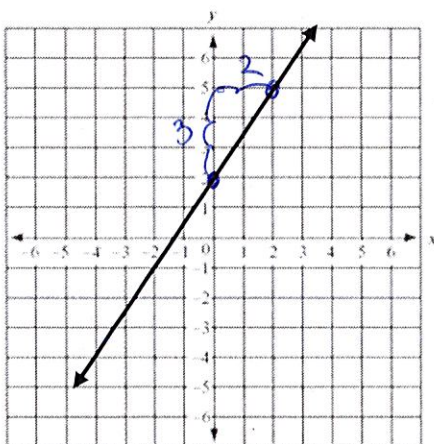
C)  $5x - y = -10$

D)  $y = -4$

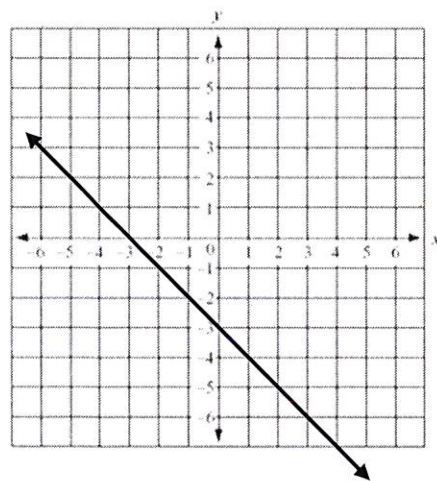
$x = -2$   $y = 10$



22. Write the slope-intercept form equation of the two lines below (8 points)



Equation:  $y = \frac{3}{2}x + 2$

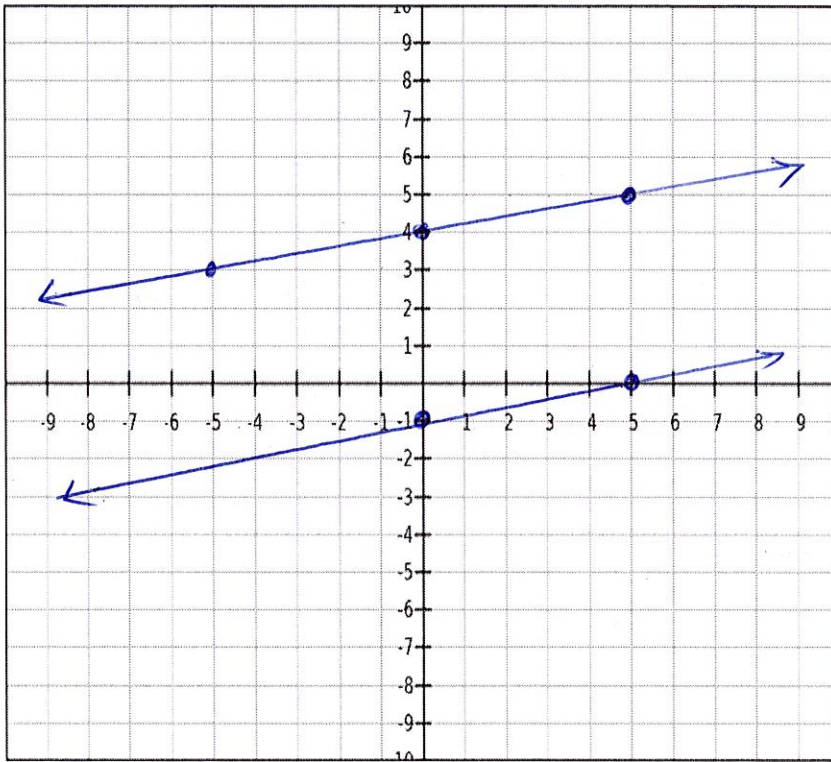


Equation:  $y = -x - 3$

**Part 8: Systems of Linear Equations (15 points)** Solve each system using the method of your choice.

Write your answer as a coordinate (if possible) in the box provided. *Tip: Check your work using substitution!*

23. Suggestion for solving (not required): Solve by GRAPHING:  $y = \frac{1}{5}x + 4$  and  $x - 5y = 5$



$$x = 5 \quad y = -1$$

No solution! 😊

SOLUTION: ( \_\_\_\_\_ , \_\_\_\_\_ )

24. Suggestion for solving (not required): Solve by SUBSTITUTION:

$$\begin{cases} x + 2y = -28 \\ y = 3x + 7 \end{cases}$$

$$x + 2(3x + 7) = -28$$

$$x + 6x + 14 = -28$$

$$7x = -42$$

$$x = -6$$

$$y = 3(-6) + 7$$
$$-18 + 7$$

$$y = -11$$

SOLUTION: ( -6 , -11 )

25. Suggestion for solving (not required): Solving by ELIMINATION:

$$\begin{aligned} & \begin{matrix} \swarrow & \searrow \\ -2 \cdot & \end{matrix} \begin{cases} 2x - 9y = -2 \\ 4x + 7y = -54 \end{cases} \rightarrow \begin{aligned} & -4x + 18y = 4 \\ & 4x + 7y = -54 \\ \hline & 25y = -50 \\ & y = -2 \end{aligned} \\ & 2x - 9(-2) = -2 \\ & 2x + 18 = -2 \\ & \quad \underline{-18} \quad \underline{-18} \\ & 2x = -20 \\ & x = -10 \end{aligned}$$

SOLUTION: ( -10 , -2 )

**Part 9: Exponential Simplification (12 points)** Simplify completely. No negative exponents, no like bases.

26. $4x^{-5}y^2 = \frac{4y^2}{x^5}$	27. $(5x^3y)^0 = 1$
28. $\frac{(2x^{-2}y^3)^3}{x^4y} = \frac{2^3x^{-6}y^9}{x^4y} = \frac{8y^8}{x^{10}}$	29. $x^3(x^1)(x^6) = x^{10}$

**Part 10: Writing and Naming Polynomials (9 points):** Write each polynomial in simplified, standard form. Then, name the polynomial by degree and by term.

30. $-10 + 5t$ Standard Form: <u><math>5t - 10</math></u> Name: <u>linear</u> <u>binomial</u>	31. $12x - 8 - 2x^2$ Standard Form: <u><math>-2x^2 + 12x - 8</math></u> Name: <u>quadratic</u> <u>trinomial</u>	32. $5,900$ Standard Form: <u><math>5,900</math></u> Name: <u>constant</u> <u>binomial</u>
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**Part 11: Polynomial Operations (16 points):** Complete each operation. Write your answers in simplified, standard form. Please **box** your final answer.

33.  $(3x^3 - 2x^2 - 1) - (-4x^3 + x^2 - 7x)$

$$\begin{array}{r} \textcircled{3x^3} - 2x^2 - 1 \textcircled{+4x^3} - x^2 + 7x \\ \hline 7x^3 - 3x^2 + 7x - 1 \end{array}$$

34.  $-3a^5b(a - 2b^3 + 6b)$

$$-3a^6b + 6a^5b^4 - 18a^5b^2$$

$$6a^5b^4 - 3a^6b - 18a^5b^2$$

35.  $(x - 3)(x - 6)$

$$x^2 - 6x - 3x + 18$$

$$\boxed{x^2 - 9x + 18}$$

36.  $(3x - 5)(x + 2)$

$$3x^2 + 6x - 5x - 10$$

$$\boxed{3x^2 + x - 10}$$

**Part 12: Factoring Polynomials (16 points)** Please factor **completely**.

37.  $16x^2 - 4x$

$$4x(4x - 1)$$

38.  $x^2 - 7x + 10$

$(x-2)(x-5)$

$$\begin{array}{r} 10 \\ 1 \ 10 \\ -2 \ -5 \end{array}$$

39.  $5x^2 + 25x + 30$

$5(x^2 + 5x + 6)$

$5(x+2)(x+3)$

$$\begin{array}{r} 6 \\ 1 \ 6 \\ 2 \ 3 \end{array}$$

40.  $2x^2 - 5x - 12$

$2x^2 + 3x - 8x - 12$

$x(2x+3) - 4(2x+3)$

$(x-4)(2x+3)$

$$\begin{array}{r} ac \\ -24 \\ 1 \ 24 \\ 2 \ 12 \\ 3 \ -8 \\ 4 \ 6 \end{array}$$

**Part 13: Multiple Choice (10 points)**

41. Which ordered pair is the solution of the following system of equations?

$$\begin{array}{l} 3x + 2y = 4 \\ -2x + 2y = 24 \end{array}$$

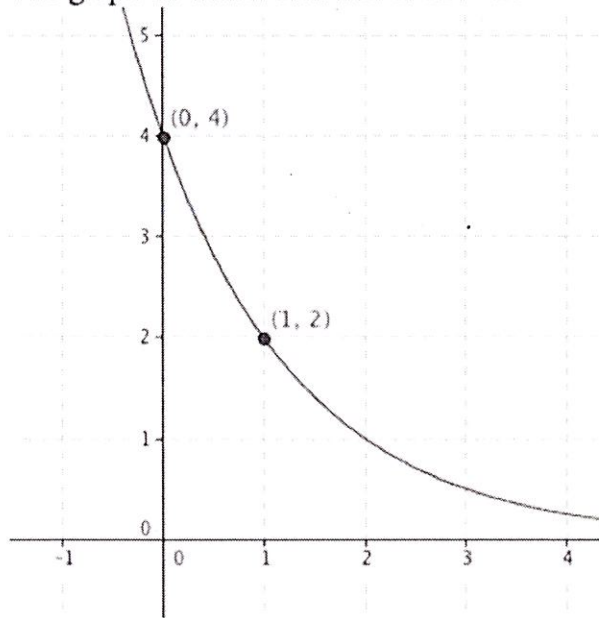
- ~~A) (2,-1)~~  
~~B) (2,-5)~~  
C) (-4,8)  
~~D) (-4,-8)~~

42. If a system of equations has **no** solution, what does the graph look like?

- A) intersecting lines  
B) parallel lines  
 C) skew lines  
 D) same line

43.

The graph of which function is shown?



A.  $y = 4x^2$

B.  $y = 4\left(\frac{1}{2}\right)^x$

C.  $y = \left(\frac{1}{2}\right)^x$

D.  $y = 4 - 2x$

44. Which of the following equations matches this input-output table?

$x$	$y$
0	1.5
1	4.5
2	13.5
3	40.5
4	121.5

a.  $y = 3x + 1.5$

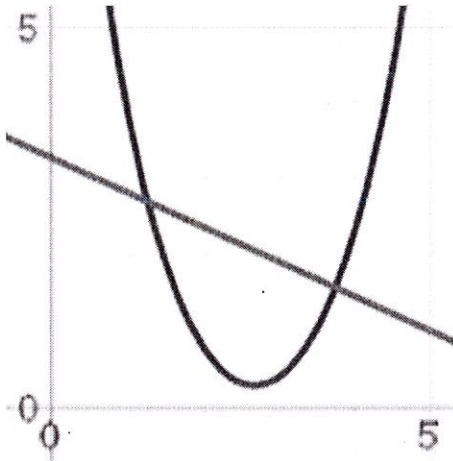
b.  $y = 4.5x + 1.5$

c.  $y = 3(1.5)^x$

d.  $y = 1.5(3)^x$

e.  $y = 3x^2 + 1.5$

45. How many solutions does the following system have?



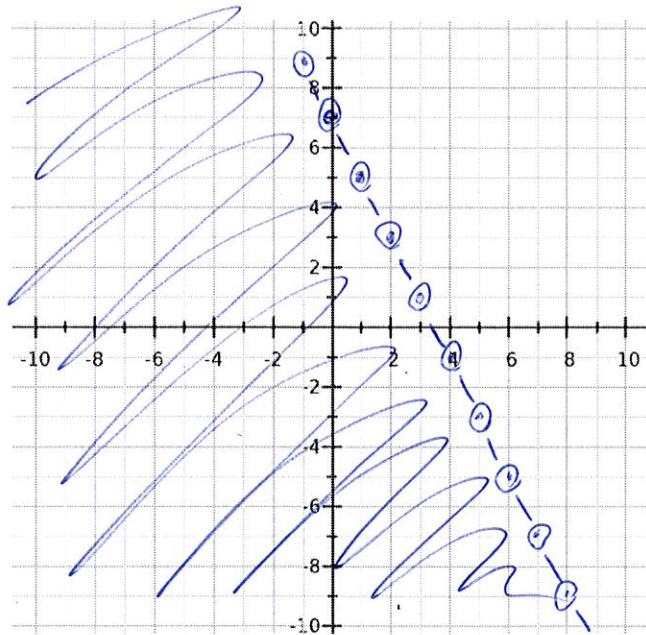
- a. No solution
- b. One solution
- c. Two solutions
- d. Five solutions
- e. Infinite solutions

### Part 13: Linear Inequalities

46. Graph the following linear inequality. Be sure to clearly indicate whether your line is dashed or solid, and clearly shade in the solution zone.

Inequality:  $y < -2x + 7$

$$\begin{aligned} 0 &< -2(0) + 7 \\ 0 &< 7 \\ \text{true} \end{aligned}$$



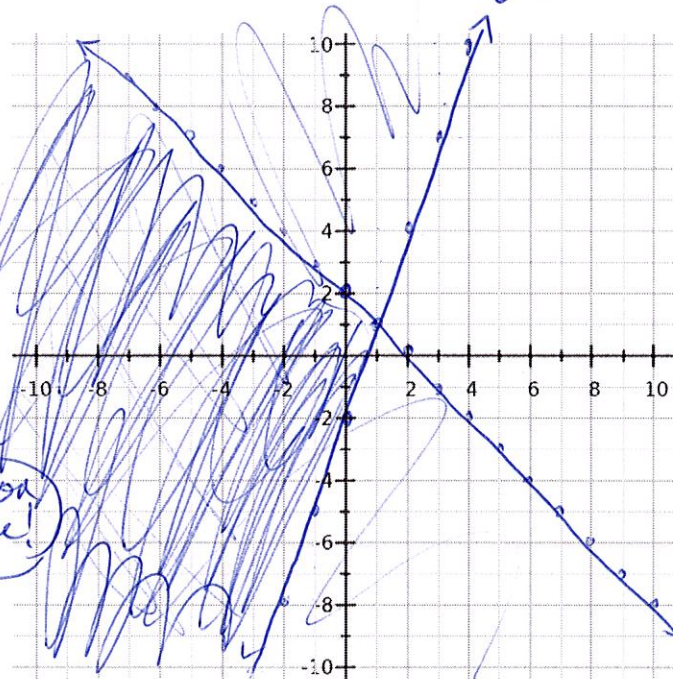
47. Graph to show the solutions to the following system of linear inequalities. Be sure to clearly indicate whether your line is dashed or solid, and clearly shade in the solution zone.

System:  $\begin{cases} y > 3x - 2 \\ y \leq -x + 2 \end{cases}$

$0 > 3(0) - 2$   
 $0 > -2$  true!

$0 \leq 0 + 2$   
 $0 \leq 2$  true!

Solution Zone!

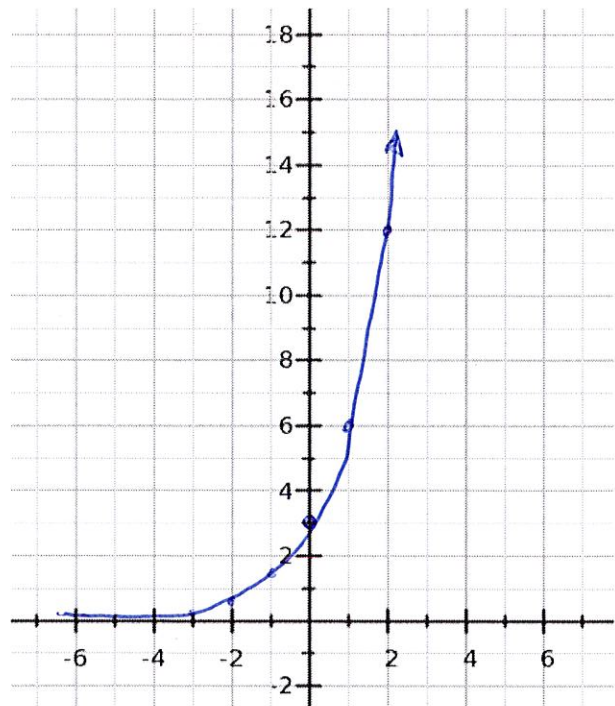


#### Part 14: Exponential Growth and Decay

48. Complete the input-output table and graph:

Equation:  $f(x) = 3(2)^x$

$x$	$f(x)$
-3	0.375
-2	0.75
-1	1.5
0	3
1	6
2	12
3	24



49. At the start of 2010 there were 450 deer in Rock Creek Park. Since then, the number of deer has grown by 2% each month. How many deer were there at the start of 2012?

$$y = 450 (1.02)^{24} =$$

$$\begin{array}{r} 100\% \\ + 2\% \\ \hline 102\% \end{array}$$

723.79 deer

50. You bought your first car 5 years ago for \$26,550. Since then, the value of the car has depreciated by 5% each year. How much is the car worth now?

$$26,550 (.95)^5 =$$

$$\begin{array}{r} 100\% \\ - 5\% \\ \hline 95\% \end{array}$$

\$ 20,543.88

### Part 15: Quadratics

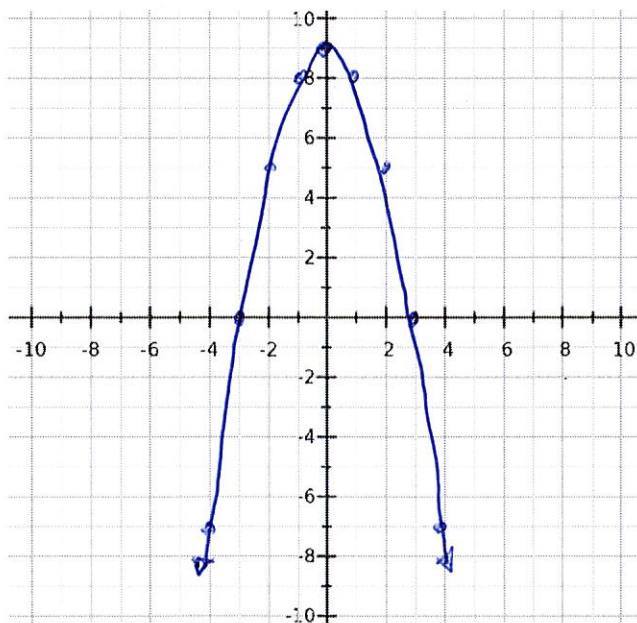
51. Graph:  $y = -x^2 + 9$

Axis of Symmetry: (0,0)

Vertex: (0,9)

$a =$  -1

-1, -3, -5, -7



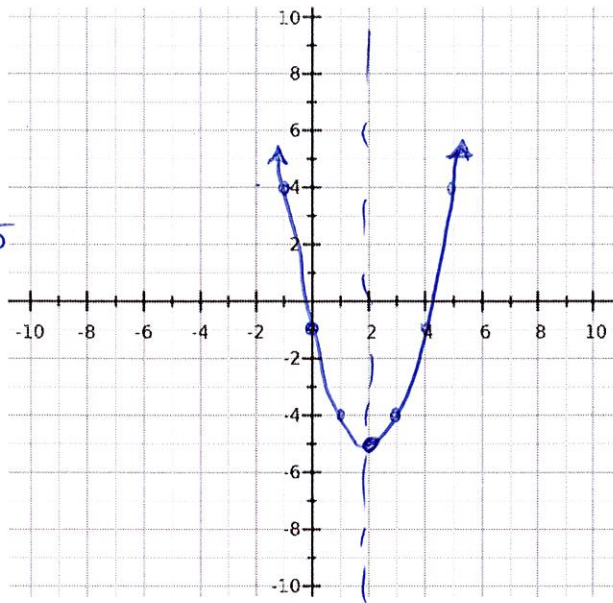
52. Graph:  $y = x^2 - 4x - 1$

Axis of Symmetry:  $-\frac{b}{2a} = \frac{4}{2} = 2$

$$(2)^2 - 4(2) - 1 = 4 - 8 - 1 = -5$$

Vertex:  $(2, -5)$

$a = 1$



53. Solve by factoring:  $x^2 - x - 20 = 0$

$$(x - 5)(x + 4) = 0$$

$$x = 5 \quad x = -4$$

$$\begin{array}{r} -20 \\ 1 \ 20 \\ 2 \ 10 \\ 4 \ -5 \end{array}$$

54. Solve by square roots:  $3x^2 - 75 = 0$

$$\frac{3x^2}{3} = \frac{75}{3}$$

$$x^2 = 25$$

$$x = \pm 5$$